

User Manual

USB Radio Sticks

deRFusb-23E00

deRFusb-23E06

deRFusb-23E06 JTAG

deRFusb-13E00

deRFusb-13E06

deRFusb-13E06 JTAG





Table of contents

1. Overview	5
2. Application.....	5
3. Features	5
4. Technical data	8
5. Mechanical size	10
6. Pin assignment.....	11
7. Programming	15
7.1. JTAG interface	15
7.2. USB interface	15
7.3. Required hardware	15
7.4. Programming and debugging details	17
8. Onboard transceiver	18
9. Onboard flash (option)	18
10. Radio certification	19
10.1. United States (FCC)	19
10.2. European Union (ETSI)	20
11. Ordering information.....	22
12. Revision notes.....	24



Document history

Date	Version	Description
2011-06-29	01.00	Initial version
2011-07-01	01.01	Update - Certification 2.4GHz usb radio stick - Working temperature - Radio data

Mailing list

Firm	Division / Name
DE	A.Palm

Author / Check / Release

	Firm	Division / Name
Author	DE	Dev. / A.Palm
Check		
release		



Abbreviations

Abbreviation	Description
ADC	Analog to D igital C onverter
AES	A dvanced E ncryption S tandard
CE	(Applications) - C onsumer E lectronics
DAC	D igital to A nalog C onverter
ETSI	E uropean T elecommunications S tandards I nstitute
FCC	F ederal C ommunications C ommission
GPIO	G enerals P urpose I nput O utput
IC	(Certification) - Industry Canada
ISM	I ndustrial, S cientific and M edical frequency band
JTAG	J oint T est A ction G roup
MAC	M edium A ccess C ontrol
MCU, μ C	M icro c ontroller U nit
PWM	P ulse W idth M odulation
RF	R adio F requency
SPI	S erial P eripheral I nterface
TWI	T wo- W ire S erial I nterface
UART	U niversal A synchronous R eceiver T ransmitter
USART	U niversal S ynchronous/ A synchronous R eceiver T ransmitter
USB	U niversal S erial B us
WPAN	W ireless P ersonal A rea N etwork



1. Overview

The compact designed USB radio sticks deRFusb-23E00 and deRFusb-13E00 contain a powerful CORTEX-M3 microcontroller with 256 kBytes High-Speed Flash. Additional flash memory to store user defined data is provided using the USB radio sticks deRFusb-23E06 and deRFusb-13E06, it is usable as mass storage device.

Depending on the transmission frequency of 2.4 GHz - deRFusb-23E00/06/JTAG - or 868/915 MHz - deRFusb-13E00/06/JTAG - the ATMEL low-power transceivers AT86RF231 or alternatively AT86RF212 are integrated. They provide a complete radio transceiver interface between the antenna and the microcontroller and an extended functional range such as a 128-Bit AES hardware engine to assure data security.

The USB radio sticks provide a programming and debugging interface to the user, by default via USB. For programming via JTAG, the variants deRFusb-23E00 JTAG, deRFusb-23E06 JTAG, deRFusb-13E00 JTAG and deRFusb-13E06 JTAG are available.

2. Application

The main applications for the USB radio sticks deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG are:

- 2.4GHz and Sub-GHz range IEEE 802.15.4
- ZigBee® Pro
- ZigBee® RF4CE
- ZigBee® IP
- 6LoWPAN
- SP100
- Wireless Sensor Networks (WSN)
- industrial and home controlling and monitoring

3. Features

The USB radio sticks deRFusb-23E00/JTAG and deRFusb-23E06/JTAG offer the following features:

- compact size (in case): 71.0 x 23.0 x 8.7 mm
- USB powered
- 3 free programmable status LEDs
- RF shielding
- Debugging/Programming interfaces: 1 x DBGU (Debug-Unit) or 1 x JTAG with 10 pin connector mounting (option 'JTAG'), USB



-
- Onboard transceiver and chip ceramic antenna 2.4GHz
 - Optional: onboard 2 GByte flash (option '06')
 - Certification: FCC certified, IC pending, conformity ETSI/CE

The block diagram below shows layout and interaction of the main deRFusb-23E00/06/JTAG components:

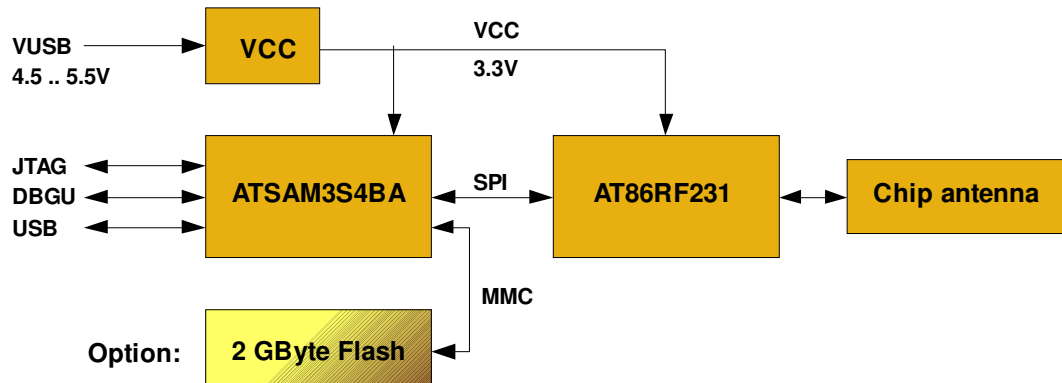


Figure 1: block diagram deRFusb-23E00/06/JTAG

The deRFusb-13E00/06/JTAG offer the same features like the deRFusb-23E00/06/JTAG except the built-in Sub-GHz transceiver and onboard Sub-GHz chip antenna.

- Onboard transceiver and chip ceramic antenna for Sub-GHz

Layout and interaction of the main deRFusb-13E00/06/JTAG components:

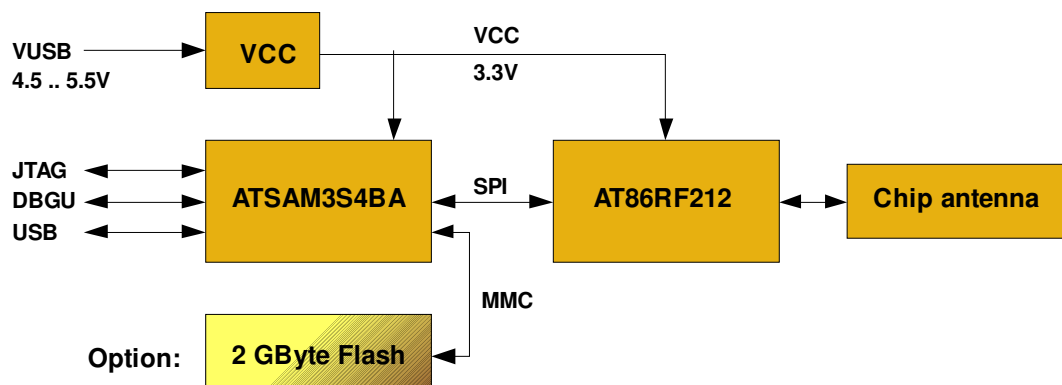


Figure 2: block diagram deRFusb-13E00/06/JTAG



4. Technical data

Table 1: Mechanical data

Mechanical	
<i>Radio module</i>	
Size (length x width x height)	71.0 x 23.0 x 8.7 mm (in case)
	63.5 x 19.0 x 5.5 mm (without case)
	63.5 x 19.0 x 9.5 mm (with JTAG, without case)
<i>Connectors</i>	
USB	chassis plug type A
10 pin header - connection option 'JTAG'	2 x 5 pins, 1.27 mm pitch

Table 2: Environment

Temperature and humidity range					
		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
Working area	T_work w/o external flash ¹	- 40		+85	°C
	T_work with external flash ²	- 25		+85	°C
Working area		25		80	% r.H.

¹ valid for deRFusb23E00/JTAG and deRFusb13E00/JTAG

² valid for deRFusb23E06/JTAG and deRFusb13E06/JTAG

Table 3: Electrical data

Electrical (VUSB = 5.0VDC)					
	<i>Parameter</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
Supply voltage	VUSB	4.5	5.0	5.5	VDC
Current consumption	I_TXon (TX_PWR = 3)		51		mA
	I_TXoff		32		mA
	I_sleep		TBD		mA
	I_RXon		TBD		mA



Table 4: Radio data transmission

Radio (VUSB = 5.0VDC)					
	<i>Parameter / feature</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
deRFusb-23E00/06/JTAG					
Antenna	Chip ceramic				
	Antenna gain		+1.3 - 0.5		dB (peak) dB (average)
	Antenna diversity: no				
Range	line of sight		>200		m
Frequency range			2.4		GHz
Transmitting power conducted	TX_PWR = 0		+3.0		dBm
Receiver sensitivity			- 101		dBm
Data rate			250 500 1 2		kb/s kb/s Mb/s Mb/s
deRFusb-13E00/06/JTAG					
Antenna	Chip ceramic				
	Antenna gain		- 0.7 - 2.6		dB (peak) dB (average)
	Antenna diversity: no				
Range	line of sight		>200		m
Frequency range			868 915		MHz (band)
Transmitting power conducted	TX_PWR = 0 @ 915MHz TX_PWR = 0 @ 868MHz			+ 9.0 + 5.0	dBm
Receiver sensitivity			- 110		dBm
Data rate			20 40 250 500 1		kb/s kb/s kb/s kb/s Mb/s

5. Mechanical size

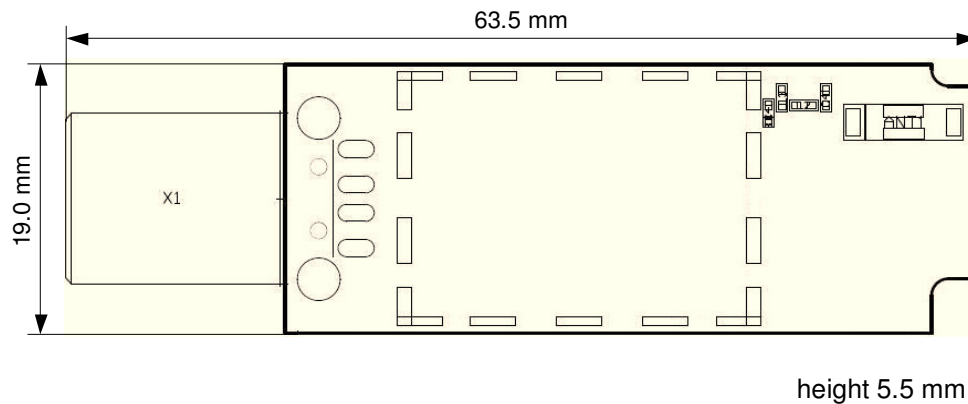


Figure 3: Size deRFusb-23E00 and deRFusb-23E06

Placed in case the mechanical size is 71.0 x 23.0 x 8.7 mm (length x width x height).

These dimensions are the same at the deRFusb-13E00 and deRFusb-13E06 radio sticks.

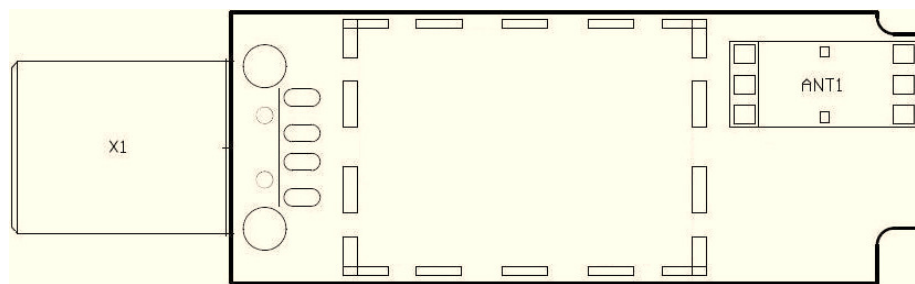


Figure 4: deRFusb-13E00 and deRFusb-13E06

The connector for all radio stick design versions is USB type A.



Figure 5: USB type A connection

6. Pin assignment

The optional 10 pin connector offers the programming interface (JTAG) and debugging interface (Debug RXD and Debug TXD) to the user. It is directly accessible from the USB stick bottom side.

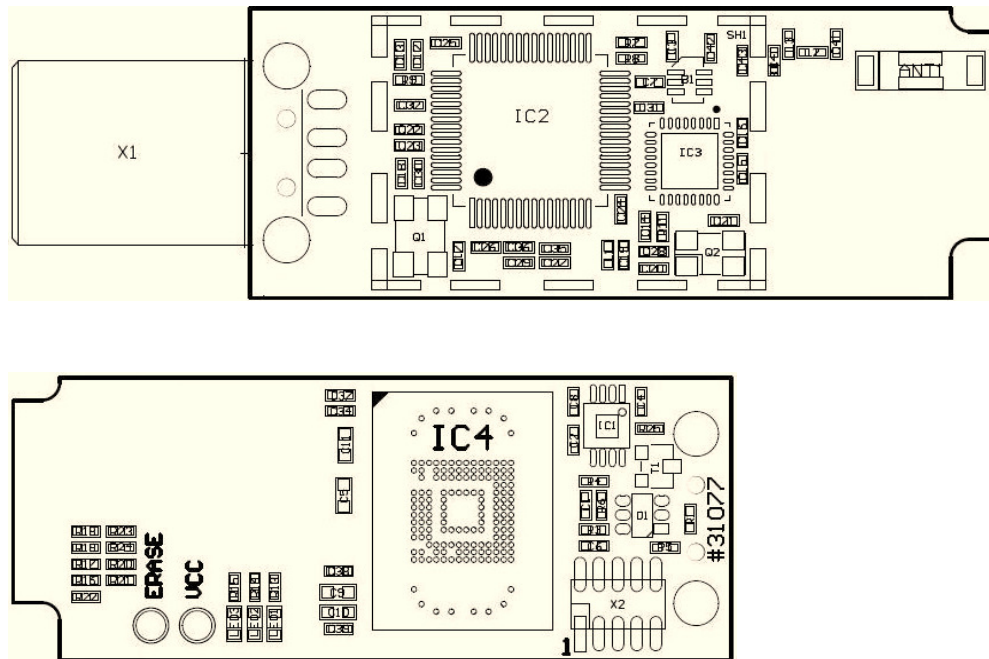


Figure 6: Top and bottom overlay deRFusb-23E00, deRFusb-23E06, deRFusb-23E00 JTAG and deRFusb-23E06 JTAG

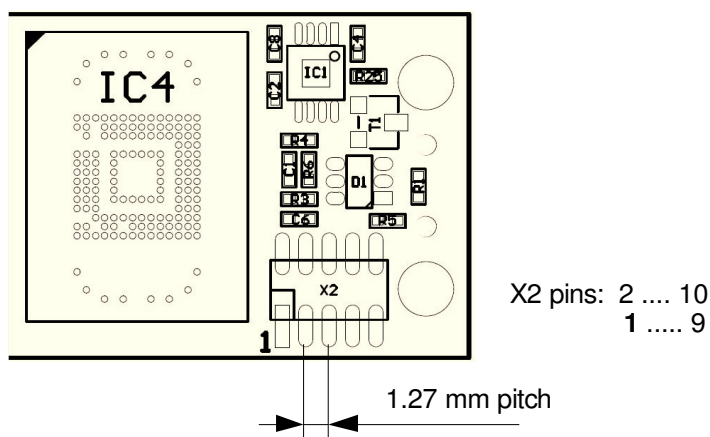


Figure 7: optional 10 pin connector with footprint receptacle

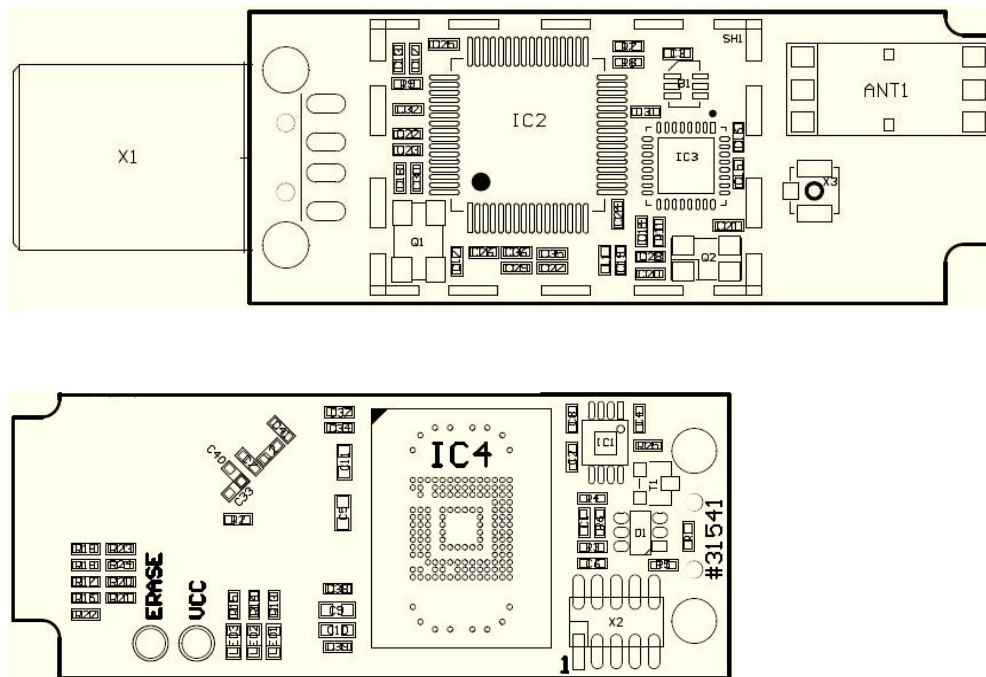


Figure 8: Top overlay deRFusb-13E00, deRFusb-13E06, deRFusb-13E00 JTAG and deRFusb-13E06 JTAG

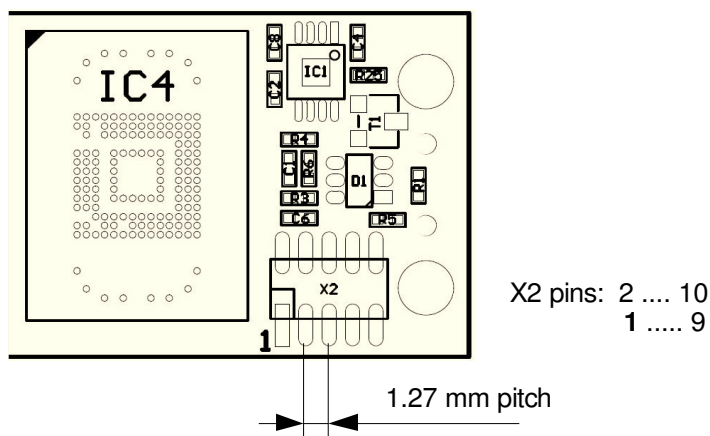


Figure 9: Optional 10 pin connector with footprint receptacle



Table 5: Pin assignment of deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG

µC Pin	name	function	comments
<i>USB connector</i>			
56	DDM	USB DM	
57	DDP	USB DP	
<i>10 pin connector (only available with option 'JTAG')</i>			
53	PB7/TCK/SWCLK	JTAG TCK	pin 1
	GND		pin 2
49	PB5/TWCK1/PWML0/WKUP13/TDO	JTAG TDO	pin 3
	VCC		pin 4
51	PB6/TMS/SWDIO	JTAG TMS	pin 5
39	NRST	/Reset	pin 6
	VCC		pin 7
30	PA9/URXD0/NPCS1/PWMFI0	Debug RXD	pin 8
33	PB4/TWD1/PWMH2/TDI	JTAG TDI	pin 9
29	PA10/UTXD0/NPCS2	Debug TXD	pin 10
<i>Miscellaneous</i>			
13	PA19/RK/PWML0/A15/AD2	LED1	red
9	PA17/TD/PCK1/PWMH3/AD0	LED2	yellow
10	PA18/RD/PCK2/A14/AD1	LED3	green
35	PA5/RXD0/NPCS3	Hardware ID1	
34	PA6/TXD0/PCK0	Hardware ID2	
32	PA7/RTS0/PWMH3/XIN32	Hardware ID3	
<i>Internal transceiver interface</i>			
20	PA15/TF/TIOA1/PWML3	RXTS/DIG2	Timestamp
11	PA21/RXD1/PCK1/AD8	SLP-TR	
21	PA14/SPCK/PWMH3	SCK	SPI
27	PA12/MISO/PWMH1	MISO	SPI
22	PA13/MOSI/PWMH2	MOSI	SPI
28	PA11/NPCS0/PWMH0	SELN	
47	PA1/PWMH1/TIOB0/A18	IRQ	
23	PA24/RTS1/PWMH1/A20	RST	Transceiver Reset
36	PA4/TWCK0/TCLK0	CLKM	
<i>2 GByte flash memory</i>			
42	MCDA0	ext. Flash Data 0	
52	MCDA1	ext. Flash Data 1	
26	MCDA2	ext. Flash Data 2	
37	MCDA3	ext. Flash Data 3	
38	MCCDA	ext. Flash Command	



41	MCCK	ext. Flash Clock	
<i>Erase pin</i>			
55	PB12/PWML1/ERASE		

Table 6: Signal description list

Signal name	Function	Type	Active level	Comments
<i>Power - USB connector</i>				
DDM	USB Full Speed Data –	Analog		
DDP	USB Full Speed Data +	Digital		
<i>JTAG</i>				
TCK	Test Clock	Input		onboard Pull-up
TDI	Test Data In	Input		onboard Pull-up
TDO	Test Data Out	Output		
TDM	Test Mode Select	Input		onboard Pull-up
<i>Reset</i>				
RSTN	Microcontroller Reset	I/O	Low	Pull-Up resistor
<i>UART0</i>				
URXD0	UART Receive Data	Input		
UTXD0	UART Transmit Data	Output		



7. Programming

7.1. JTAG interface

Only the deRFusb-23E00 JTAG, deRFusb-23E06 JTAG, deRFusb-13E00 JTAG and deRFusb-13E06 JTAG can be programmed over JTAG interface (TDI, TDO, TCK, TMS) with a suitable JTAG-programmer for ARM-based microcontrollers.

7.2. USB interface

The alternative programming feature for the deRFusb radio sticks is provided by the USB interface.

The interface represents a USB 2.0 Full-Speed Device (not USB certified). The USB interface logs on at the host as Mass Storage Device and as deRFusb-xxxx.

For a more details of the interface please refer to the ATSAM3S ATMEL data sheet:

- Preliminary PDF: doc6500.pdf
- Preliminary Summary PDF: 6500s.pdf

http://www.atmel.com/dyn/products/product_docs.asp?category_id=163&family_id=605&subfamily_id=2127&part_id=4691

7.3. Required hardware

JTAG interface

For the JTAG interface Dresden elektronik ingenieurtechnik gmbh offers the hardware components for a fast start-up. The following hardware setups are possible:

1. Option ATMEL SAM-ICE programmer
 - (A) deRFusb-23E00/06 JTAG or deRFusb-13E00/06 JTAG
 - (B) SAM-ICE-Adapter with onboard RS232 level shifter
 - (C) SAM-ICE programmer
 - (D) RS232 cable

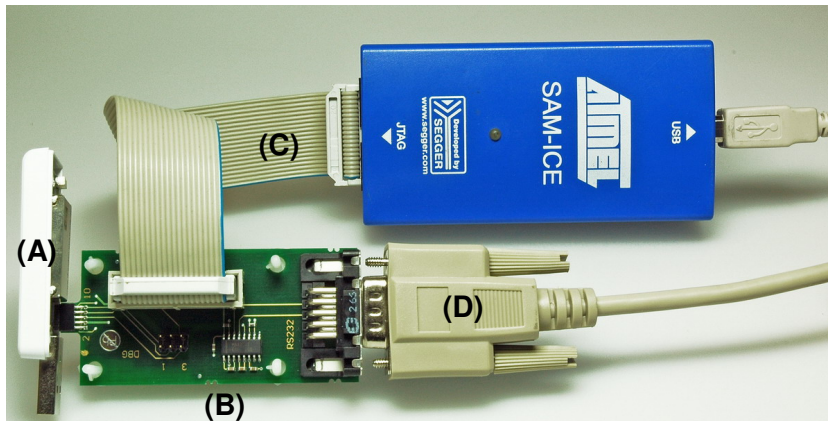


Figure 10: USB radio stick with SAM-ICE programmer

2. Option OLIMEX ARM programmer

- (A) deRFusb-23E00/06 or deRFusb-13E00/06
- (B) SAM-ICE-Adapter with onboard RS232 level shifter
- (C) Olimex USB-ARM programmer
- (D) RS232 cable

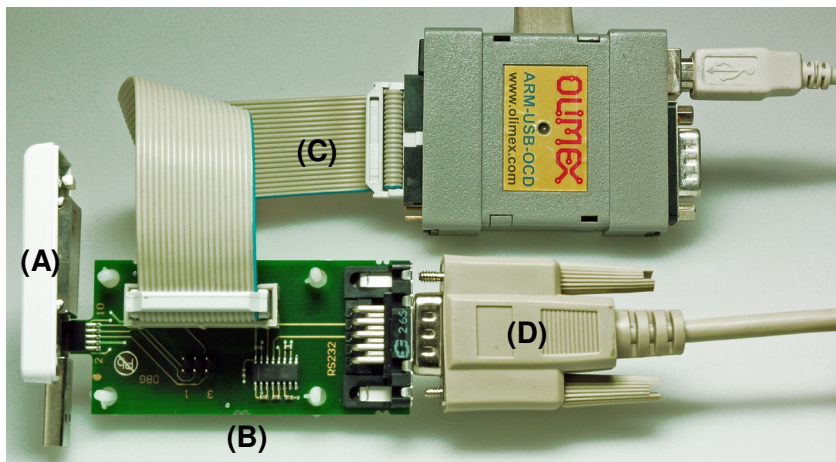


Figure 11: USB radio stick with OLIMEX ARM programmer

Attention: The SAM-ICE-Adapter has no own power supply! Connect the USB radio stick with an USB Type-A extension cable to a laptop or PC.



USB interface

No additional hardware is necessary using the USB interface to program the deRFusb-23E00/06 and deRFusb-13E00/06 radio sticks.

7.4. Programming and debugging details

For programming via JTAG there are two alternatives:

- OpenOCD
- Segger J-Link or Atmel SAM-ICE.

OpenOCD

A suitable on chip debug system including flash programming and SRAM debugging support is available from various vendors e.g. <http://www.olimex.com/dev/arm-usb-ocd.html>

This open source programming software is recommended for open source toolchains.

Dresden elektronik ingenieurtechnik gmbh provides scripts for ease of use.

Segger J-Link or Atmel SAM-ICE

These In-Circuit-Emulators are commercially available programming adapters. They work well with e.g. the IAR embedded workbench. They are also working with the GDB debug server (for use with open source toolchain).

The programming and debugging features are license dependent.

Debugging and tracing - required hardware

Debugging and tracing of the USB radio sticks is possible with the SAM-ICE adapter. It has following features:

- 10 pin connector for deRFusb-23E00/06 JTAG and deRFusb-13E00/06 JTAG
- 20 pin connector for ARM JTAG programmer
- 6 pin connector for ARM Debug-Unit
- RS232 connector with onboard RS232 level shifter for ARM Debug-Unit

Troubleshooting

The ERASE pin (see section 6) is used to reinitialize the Flash content - and some of its NVM (Non-Volatile Memory) bits - to an erased state. The flash is transferred to its original state.

The pin must be tied high during more than 220 ms to perform a Flash erase operation.



8. Onboard transceiver

The main difference between the deRFusb-23E00/06/JTAG and the deRFusb-13E00/06/JTAG USB radio sticks is the built-in 2.4GHz or alternatively Sub-GHz transceiver in combination with the appropriate onboard chip antenna.

deRFusb-23E00/06/JTAG - AT86RF231 transceiver

The low-power 2.4GHz transceiver is designed for industrial and consumer IEEE 802.15.4, ZigBee®, RF4CE, SP100 and high data rate ISM applications.

deRFusb-13E00/06/JTAG - AT86RF212 transceiver

The low-power, low-voltage 800/900MHz transceiver is designed for low-cost IEEE 802.15.4, ZigBee® and high data rate ISM applications available Europe and North America.

General transceiver description

These single-chip radio transceivers provide a complete radio transceiver interface between an antenna and a microcontroller.

They comprise the analog radio transceiver and the digital modulation and demodulation including time and frequency synchronization and data buffering. The number of external components is minimized such that only the antenna, the crystal and decoupling capacitors are required. The bidirectional differential antenna pins are used for transmission and reception, thus no external antenna switch is needed.

An internal 128 byte RAM for RX and TX buffers the data to be transmitted or the received data. Two on chip low dropout voltage regulators provide the internal analog and digital 1.8V supply.

The transceivers further contain comprehensive hardware-MAC support (Extended Operating Mode) and a security engine (AES) to improve the overall system power efficiency and timing.

9. Onboard flash (option)

A 2 GByte flash memory to store user defined data is optionally available using the deRFusb-23E06/JTAG and deRFusb-13E06/JTAG USB radio sticks.

This flash memory is typically applied as mass storage device for user data. It works like a Multimedia Card (MMC). Possible data bit modes are 1bit (default) and 4bit.

The flash is equipped with a memory controller and has a NAND flash architecture. It complies with eMMC Specification Version 4.4. The temperature range for safe operation is from - 25C° to +85C°.



10. Radio certification

10.1. United States (FCC)

The deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG USB radio sticks comply with the requirements of FCC part 15.

The FCC certification for deRFusb-13E00/06/JTAG is pending.

To fulfill FCC Certification requirements, an OEM manufacturer must comply with the following regulations:

The modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, the outside of the device into which the module is installed must also display a label referring to the enclosed module.

This exterior label can use wording such as the following. Any similar wording that expresses the same meaning may be used.

**Sample label for USB radio stick deRFusb-23E00, deRFusb-23E06,
deRFusb-23E00 JTAG and deRFusb-23E06 JTAG:**

FCC-ID: XVV-ARM323E00
<i>This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.</i>

Note: The usb radio sticks deRFusb-23E00 JTAG, deRFusb-23E06 and deRFusb-23E06 JTAG fulfill a Permissive Change Class 1 regarding to FCC Section 2.1043 and complies with the requirements of FCC part 15.

The Original Equipment Manufacturer (OEM) must ensure that the OEM modular transmitter is labeled with its own FCC ID number. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown below. If the FCC ID is not visible when the equipment is installed inside another device, the outside of the device into which the equipment is installed must also display a label referring to the enclosed equipment.

This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation (FCC 15.19). The internal / external antenna(s) used for this mobile transmitter must provide a separation distance of at least 20 cm from all persons and must not be co-located or operate in conjunction with any other antenna or transmitter.

Installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. This device is approved as a mobile de-



vice with respect to RF exposure compliance, and may only be marketed to OEM installers. Use in portable exposure conditions (FCC 2.1093) requires separate equipment authorization.

Modifications not expressly approved by this company could void the user's authority to operate this equipment (FCC section 15.21).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

10.2. European Union (ETSI)

The deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG USB radio sticks have been tested compliant for use in the European Union countries.

If the deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG USB radio sticks are incorporated into a product, the manufacturer must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

The manufacturer must maintain a copy of the deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG USB radio sticks documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

The "CE" marking must be affixed to a visible location on the OEM product. The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.



-
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
 - The CE marking must be affixed visibly, legibly, and indelibly.

More detailed information about CE marking requirements you can find at "DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" on 9 March 1999 at section 12.



11. Ordering information

The product name includes the following information:

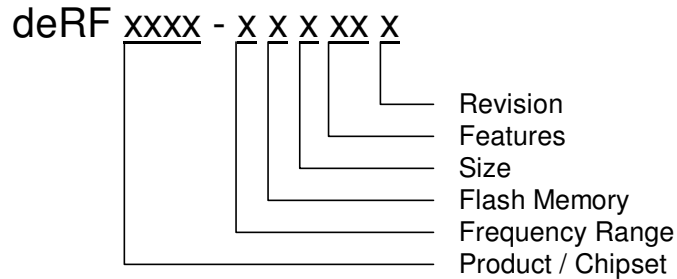


Table 7: product name code

Product name code			
Information	Code	Explanation	Comments
Product / Chipset	usb	AT91SAM7S	USB radio stick
Frequency range	1	868/915 MHz	
	2	2.4 GHz	
Flash memory	3	256 kByte	
Size	E	USB stick	
Features	00	chip antenna	onboard
	06	chip antenna, 2 GB flash	onboard
	JTAG	10 pin connector	JTAG + DEBUG
Revision	<blank>	Rev 0	



Table 8: ordering information

Ordering information		
Part number	Product name	Comments
coming soon	deRFusb-23E00	USB radio stick for 2.4 GHz (delivered with a fitting case)
BN-032310	deRFusb-23E00 JTAG	USB radio stick for 2.4 GHz with assembled JTAG connector
coming soon	deRFusb-23E06	USB radio stick for 2.4 GHz with 2 GByte flash - (delivered with a fitting case)
coming soon	deRFusb-23E06 JTAG	USB radio stick for 2.4 GHz with 2 GByte flash with assembled JTAG connector
coming soon	deRFusb-13E00	USB radio stick for Sub-GHz (delivered with a fitting case)
coming soon	deRFusb-13E00 JTAG	USB radio stick for Sub-GHz with assembled JTAG connector
coming soon	deRFusb-13E06	USB radio stick for Sub-GHz with 2 GByte flash - (delivered with a fitting case)
coming soon	deRFusb-13E06 JTAG	USB radio stick for Sub-GHz with 2 GByte flash with assembled JTAG connector
BN-028337	SAM-ICE-Adapter	program and debug interface adapter for USB radio sticks



12. Revision notes

Up to now for the deRFusb-23E00/06/JTAG and deRFusb-13E00/06/JTAG USB radio sticks technical problems, malfunctions or any other critical issues are not known.



dresden elektronik ingenieurtechnik gmbh
Enno-Heidebroek-Straße 12
D-01237 Dresden
GERMANY

Tel. +49 351 - 31 85 00 | Fax +49 351 - 318 50 10
E-Mail wireless@dresden-elektronik.de
General manager: Dipl.-Ing. L. Pietschmann
Commercial Registry: HRB 749 Dresden Municipal Court
Tax number: 201/107/00726
Sales tax identification number: DE 140125678

Trademarks and acknowledgements

- ZigBee® is a registered trademark of the ZigBee Alliance.
- 802.15.4™ is a trademark of the Institute of Electrical and Electronics Engineers (IEEE).

These trademarks are registered by their respective owners in certain countries only. Other brands and their products are trademarks or registered trademarks of their respective holders and should be noted as such.

Disclaimer

This note is provided as-is and is subject to change without notice. Except to the extent prohibited by law, dresden elektronik ingenieurtechnik gmbh makes no express or implied warranty of any kind with regard to this guide, and specifically disclaims the implied warranties and conditions of merchantability and fitness for a particular purpose. dresden elektronik ingenieurtechnik gmbh shall not be liable for any errors or incidental or consequential damage in connection with the furnishing, performance or use of this guide.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or any means electronic or mechanical, including photocopying and recording, for any purpose other than the purchaser's personal use, without the written permission of dresden elektronik ingenieurtechnik gmbh.

Copyright © 2011, dresden elektronik ingenieurtechnik gmbh. All rights reserved.